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RESEARCH ARTICLE

Floras of the Archatinskoe and Chernovinskoe Forestries of the Katon-Karagay State National Nature Park (the Republic of Kazakhstan)

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Abstract

Synopses of vascular plant species and subspecies, registered in two forestries of the Katon-Karagay State National Nature Park (the Republic of Kazakhstan) are presented. A total of 393 species/subspecies were registered in the Archatinskoe Forestry and 383 taxa were found in the Chernovinskoe Forestry. Nine taxa have been included in the List of Rare and Endangered Plant Species of the Republic of Kazakhstan: *Huperzia selago* (L.) Bernh. ex Schrank et Mart., *Paeonia anomala* L., *P. hybrida* Pall., *Rheum altaicum* Losinsk., *Rhodiola rosea* L., *Fornicium carthamoides* (Willd.) Kamelin (= *Rhaponticum carthamoides* (Willd.) Iljin.), *Lilium pilosiusculum* (Freyn) Miscz. (= *L. martagon* L.), *Erythronium sibiricum* (Fisch. et C.A. Mey.) Krylov, and *Dactylorhiza fuchsii* (Druce) Soó.

Keywords

Biogeography, cobweb spiders, cryptic species, DNA barcoding

Introduction

The Katon-Karagay State National Nature Park (KKSNNP) was established in Katon-Karagay District of the Republic of Kazakhstan in 2001. Its principal tasks are to protect the unique nature of Kazakhstan Altai, to stimulate the district economy

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and to develop traditional local crafts and national culture. The area of the park is almost 6,435 km2 or 643,477 ha (Zhumagulov 2006). Since 2017, the KKSNNP with the Katunskiy State Nature Biosphere Reserve and the Belukha Nature Park (Russian Federation) became a part of the Great Altai Transboundary Biosphere Reserve (Ibisch et al. 2015).

An inventarisation of biological objects it is a necessary tool for the biodiversity conservation in any protected area. At present the majority of protected areas in the Republic of Kazakhstan have synopses or checklists of vascular plants. Thus, the results of plant inventarisation were published for the protected areas of the KKSNNP: the Ukok Quiet Zone (Djachenko 1995), the Markakol' Reserve (Utyasheva 2009), the Katunskiy Reserve (Artemov 2012), and the Belukha Nature Park (Artemov 2018). N.K. Aralbaev, M.P. Danilov and E.B. Isaev investigated the vegetation of the Rakhmanov Springs Botanical-Geological Reserve in 2003, M.P. Danilov worked on the Burkhat Pass and in its surroundings in 2005, and a team of botanists headed by I.O. Baytulin explored distribution, abundance, biological and ecological features of medical plants on the Listvyaga Range in 2004–2006 (Chelyshev 2006). However, the results of these investigations were presented as the reports, rather than publications. Later, P.N. Krylov in the Flora of Western Siberia indicated some species locations in the upper reaches of the White Berel' River, at the Rakhmanov Springs, on the Narymskiy and Sarymsakty Ranges (Krylov 1927, 1928, 1931a, b, 1933, 1935, 1937, 1939, 1949); E.B. Isaev published the vascular plant synopsis of the Southern Altai Range (Isaev 1993); R.N. Krykbaeva publisped a paper on the dendroflora of the KKSNNP (Krykbaeva 2006); I.A. Artemov published a checklist of plants recorded in the upper reaches of the White Berel' River (Artemov 2019). Besides, Yu.A. Kotukhov and D.A. German described several new species from the territory of the KKSNNP (Kotukhov 1992, 1999; German 2004). These studies were mainly performed in the north-western, north-eastern and southern parties of the KKSNNP. Thus, a generalized vascular plant synopsis of the KKSNNP has not been compiled and published to date.

The purpose of the present work is to make an inventory of vascular plants in the areas of the KKSNNP, which were not explored by botanists: the Archatinskoe Forestry in the eastern part and the Chernovinskoe Forestry in the central part of KKSNNP.

Material and methods

The inventory was carried out in the Archatinskoe Forestry in the upper reaches of the Bukhtarma River and in the Chernovinskoe Forestry on the southern principal slope of the Listvyaga Range in the vicinity of Lake Maral'e and in the upper reaches of the Chernovaya River (Fig. 1). Two sites in every forestry were explored to ensure the maximum coverage of species and coenotic diversity: one of them in alpine and

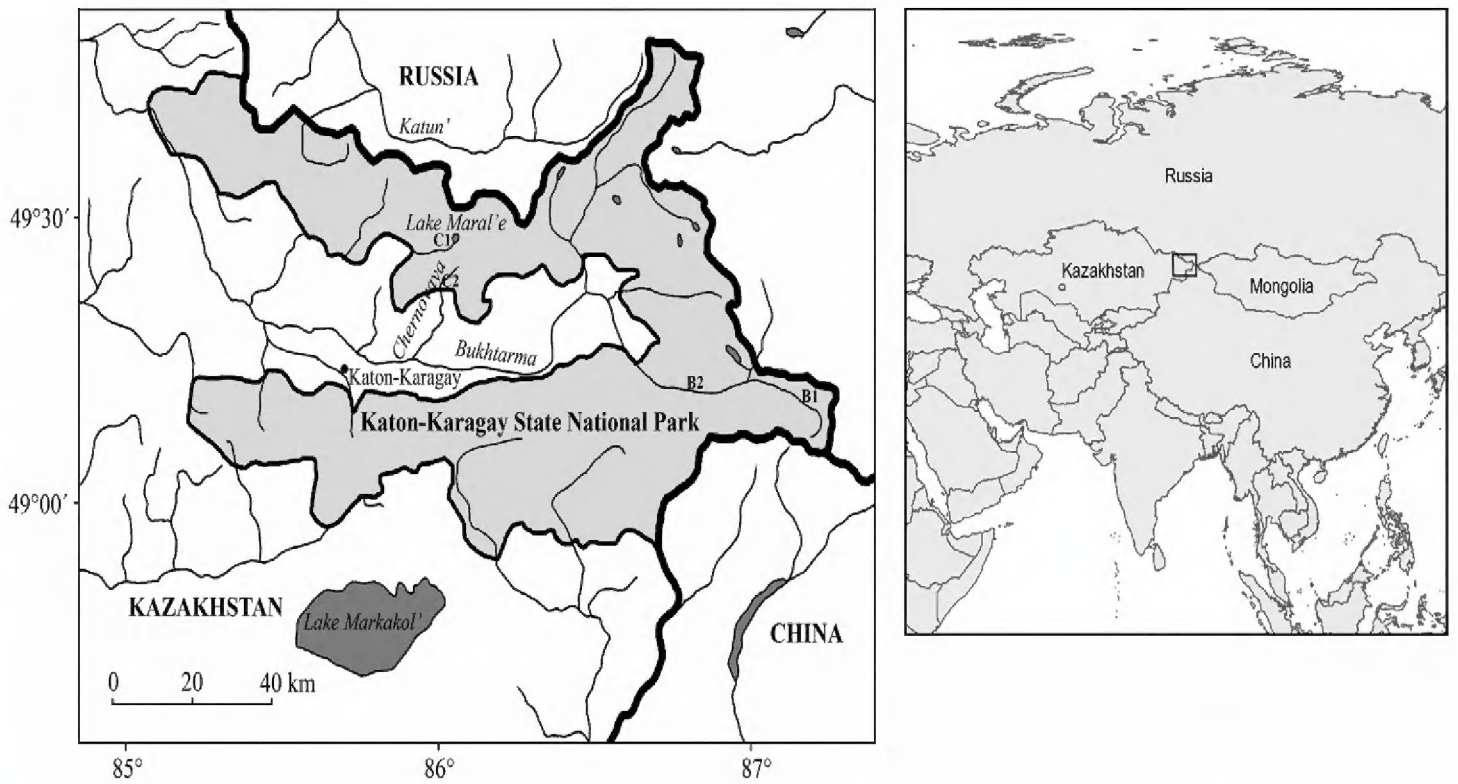

Figure 1. Map of the Katon-Karagay State National Nature Park. Explored sites: Archatinskoe Forestry: **B1** – upper reaches of the Bukhtarma River; **B2** – valley of the Bukhtarma River; Chernovinskoe foresty: **C1** – southern principal slope of the Listvyaga Range, Lake Maral'e; **C2** – upper reaches of the Chernovaya River (the map base was adopted from Ibisch et al. 2015).

subalpine vegetation belts and the other in forest and forest-steppe belts. In every site, the vascular plant species were registered and collected during walking routes. The research was done within 30.07–15.08.2009.

The total data set contains 1,718 records of species locations, 158 of them were confirmed by the collected specimens identified by the 'Flora of Siberia' (Malyschev 2000, 2006; Malyschev and Peschkova 2001a, 2001b, 2001c, 2003, 2004; Krasnoborov and Malyschev 2003; Polozhij and Malyschev 2004, 2006; Peschkova 2006; Krasnoborov 2007; Polozhij and Peschkova 2007) and were given to the herbarium of the Central Siberian Botanical Garden SB RAS (NS). The synopses of the Archatinskoe and Chernovinskoe Forestries are compiled on the base of this data set.

The names and circumscription of taxa in the synopses were accepted according to 'Conspectus of the flora of Asian Russia' (Baikov 2012). Authors of taxa were given in accordance to the standard, endorsed by the International Working Group on Taxonomic Databases for Plant Sciences (Brummitt and Powell 1992). Families of flowering plants were presented according to the Takhtajan system (Takhtajan 2009). Genera and species were arranged alphabetically. The number of genera and species were given in brackets after a family name. For each species, a list of plant communities, habitats and collection sites were given. Collected species were marked by asterisk. The landscapes presented in our article were photographed by Olympus SP-550UZ camera.

Figure 2. Site **B1**. Upper reaches of the Bukhtarma River.

Sites description

Archatinskoe foresty

Site B1 (Fig. 2). The coordinates of the center are 49°13′N, 87°12′E, the absolute altitudes vary from 2,250 to 2,700 m a.s.l. The site is situated in the upper reaches of the Bukhtarma River between the northern spurs of the Southern Altai Range and the south-western spurs of the Ukok Plateau. Riverine scrub, alpine meadows, bog communities and plant aggregations on pebble are common along the river banks. The northern slopes of the valley are covered by subalpine open forests of *Pinus sibirica* and *Betula rotundifolia* scrub with rare low trees of *Pinus sibirica* and *Larix sibirica*. The southern slopes are mainly covered by *Kobresia* alpine meadows with patches of dryad tundra. Alpine short grass meadows with *Ranunculus altaicus*, bushy tundras with *Betula rotundifolia*, low bush tundras with *Salix nummularia* or *S. turczaninowii* and dryad tundras are common above the timber-line. Rocks and boulder fields with the characteristic complexes of *Dryopteris fragrans* or *Ribes altissimum* are common as well.

Site B2 (Fig. 3)**.** The coordinates of the center are 49°13′N, 86°51′E, the absolute altitudes vary from 1,500 to 1,650 m a.s.l. The site is situated in the valley of the Bukhtarma River. Aggregations of sparse plants on pebble are presented along the river banks. Steppe meadows (*Achillea asiatica*, *Fragaria viridis*) occupy river terraces. The

Figure 3. Site **B2**. Valley of the Bukhtarma River.

right valley side has mainly southern exposure. Its low part is occupied by exposure-related stony steppes (*Potentilla acaulis*, *Artemisia frigida*, *Carex korshinskyi*) interrupted by stony screes in some places. Rocks, *Juniperus sabina* scrub and meadows predominate in its upper part. Slopes of the left valley side has northern and north-eastern exposure and occupied by mountain taiga with *Picea obovata* and *Larix sibirica*.

Chernovinskoe foresty

Site C1 (Fig. 4). The coordinates of the center are 49°25′N, 85°59′E, the absolute altitudes vary from 1,820 to 2,370 m a.s.l. The site is situated on the southern principal slope of the Listvyaga Range in the vicinity of Lake Maral'e. The lake is located in a depression with gentle slopes. Banks of the lake are boggy (*Juncus filiformis*, *Carex cespitosa*, *C. rhynchophysa*, *Equisetum fluviatile*). The southern slopes are covered by subalpine meadows (*Veratrum lobelianum*, *Cirsium helenioides*, *Fornicium carthamoides*, *Dactylis glomerata*), subalpine scrub (*Betula rotundifolia*, *Salix glauca*) and alpine meadows (*Dracocephalum grandiflorum*, *Aquilegia glandulosa*, *Anthoxanthum alpinum*). The northern slopes are covered by open woodlands with *Larix sibirica* and subalpine scrub and occasionally interrupted by boulder fields. Around the lake, there are several rather low (2,300-2,400 m a.s.l.) and gentle mountains with dominant alpine and tundra communities.

Figure 4. Sit **C1**. Southern principal slope of the Listvyaga Range, Lake Maral'e.

Site C2 (Fig. 5). The coordinates of the center are 49°20′N, 86°00′E, the absolute altitudes vary from 1,390 to 1,490 m a.s.l. The site is situated on the southern principal slope of the Listvyaga Range in the upper reaches of the Chernovaya River (the valley of the Putevochnyi Stream). The bottom of the stream valley is covered by dark coniferous boggy forest with grass layer (*Equisetum sylvaticum*, *Caltha palustris*, *Cardamine macrophylla*, *Stellaria bungeana* and other hygrophytes). Meadow steppes (*Fragaria viridis*, *Phleum phleoides*, *Achillea asiatica*, *Artemisia sericea*, *Hypericum perforatum*, *Origanum vulgare*, *Phlomoides tuberosa*), scrub communities (*Spiraea media*, *Rosa spinosissima*, *Cotoneaster melanocarpus*) and stony steppes (*Ziziphora clinopodioides*, *Tanacetum tanacetoides*, *Orostachys spinosa*) are presented on the southern slopes. Meadows with *Dactylis glomerata*, *Phleum pratensis*, *Festuca pratensis*, *Filipendula ulmaria*, *Bupleurum longifolium,* occasional trees of *Larix sibirica* and shrubs of *Lonicera tatarica* can be seen on western gentle slopes. The northern slopes are occupied by mountain taiga with grass layer and forest meadows.

Results

Vascular plant synopsis of the Archatinskoe forestry of KKSNNP

Equisetaceae (1/2).

Equisetum arvense L.: river and stream banks, wet meadows; B1.

Figure 5. Site **C2**. Southern principal slope of the Listvyaga Range in the upper reaches of the Chernovaya River.

E. pratense Ehrh.: stony river bank in B2.

Botrychiaceae (1/1).

Botrychium lunaria (L.) Sw.: meadow patch in boulder field among *Betula rotundifolia* scrub in B1.

Polypodiaceae (1/1).

Polypodium vulgare L.: edge of larch-spruce forest in B2.

Dryopteridaceae (1/1).

Dryopteris fragrans (L.) Schott: boulder fields; B2.

Athyriaceae (1/1).

Cystopteris fragilis (L.) Bernh.: rocks; B2 (*).

Woodsiaceae (1/1). *Woodsia asiatica* Schmakov et Kiselev: rocks, boulder fields; B1, B2.

Pinaceae (3/3).

Larix sibirica Ledeb.: forests, subalpine open forests, *Betula rotundifolia* scrub; B1, B2.

Picea obovata Ledeb.: forests; B2

Pinus sibirica Du Tour: forests, subalpine open forests, *Betula rotundifolia* scrub; B1, B2.

Cupressaceae (1/3).

Juniperus pseudosabina Fisch. et C.A. Mey.: boulder fields, subalpine scrub; B1.

J. sabina L.: stony steppes, boulder fields; B2.

J. sibirica Burgsd.: boulder fields, tundras; B1.

Berberidaceae (1/1).

Berberis sibirica Pall.: boulder fields, stony steppes, steppe meadows; B1, B2.

Ranunculaceae (13/22).

Aconitum anthoroideum DC.: meadows, scrub; B1, B2.

A. decipiens Vorosch. et Anfalov: subalpine scrub, meadows; B1 (*).

A. leucostomum Vorosch.: meadows; B1.

Actaea cimicifuga L.: forests, meadows, boulder fields; B2.

Adonis sibirica Patrin: forests, meadows; B2.

Anemonastrum crinitum (Juz.) Holub: alpine meadows; B1.

Aquilegia glandulosa Fisch. ex Link: alpine and subalpine meadows; B1.

Atragene sibirica L.: forests, boulder fields; B1, B2.

Callianthemum sajanense (Regel) Witasek: alpine meadow in B1.

Caltha palustris L.: stream banks, wet meadows; B1.

Delphinium ukokense Serg.: alpine meadow in stream valley; B1 (*).

Pulsatilla nuttalliana (DC.) Spreng.: meadow patch in boulder field; B1.

Ranunculus altaicus Laxm.: alpine and nival meadows; B1 (*).

R. grandifolius C.A. Mey.: meadows; B1.

R. lasiocarpus C.A. Mey.: wet alpine meadow in B1 (*).

R. natans C.A. Mey.: bayou in B1.

R. polyanthemos L.: meadow at edge of spruce-larch forest in B2.

Thalictrum alpinum L.: alpine meadow in B1.

T. foetidum L.: stony steppes, steppe meadows, rocks; B2.

T. minus L.: meadows, forests; B2.

T. simplex L.: meadows; B1, B2.

Trollius altaicus C.A. Mey.: meadows; B1.

Papaveraceae (2/3).

Chelidonium majus L.: roadside of country road in B2.

Papaver croceum Ledeb.: meadows; B1, B2 (*).

P. tianschanicum Popov: *Kobresia* alpine meadows, rocks; B1 (*).

Paeoniaceae (1/1).

Paeonia anomala L.: larch-birch-spruce forest in B2.

Betulaceae (1/2).

Betula pendula Roth: forests, forest edges; B2.

B. rotundifolia Spach: bushy tundras, subalpine scrub, meadows; B1.

Caryophyllaceae (9/21).

Cerastium arvense L.: forb-fescue meadow in B1 and steppe meadow in B2.

C. davuricum Fisch. ex Spreng.: forb meadow in stream valley; B1.

C. holosteoides Fries: steppe on river terrace in B2.

C. lithospermifolium Fisch.: scree in B1.

C. pauciflorum Steven ex Ser.: forests, subalpine scrub, meadows; B1, B2.

C. pusillum Ser.: *Kobresia* alpine meadow in B1.

Dianthus superbus L.: meadows; B1.

D. versicolor Fisch. ex Link: stony steppe in B2.

Dichodon cerastioides (L.) Rchb.: wet meadows, tundras; B1.
Elisanthe aprica (Turcz. ex Fisch. et C.A. Mey.) Peschkova: stony steppes; B2 (*).
Gastrolychnis brachypetala (Hornem.) Tolm. et Kozhanch.: steppe meadow in B1 (*).
G. tristis (Bunge) Czerep.: alpine meadow in stream valley; B1 (*).
Minuartia biflora (L.) Schinz et Thell.: stony tundra and stony trail in B1.
M. verna (L.) Hiern: tundras, rocks; B1.
Moehringia umbrosa (Bunge) Fenzl: forests, forest edges; B2.
Silene amoena L.: meadows; B2.
S. graminifolia Otth: rocks, alpine meadows, stony steppes; B1, B2.
Stellaria bungeana Fenzl: forest in B2.
S. dichotoma L.: stony steppes; B2.
S. graminea L.: meadows; B1 (*).
S. longifolia Muehl. ex Willd.: wet meadow in B1 (*).

Chenopodiaceae (3/3).
Axyris amaranthoides L.: stony steppes; B2.
Chenopodium album L.: roadside of country road in B2.
Teloxys aristata (L.) Moq.: stony steppe in B2.

Polygonaceae (7/9).
Acetosa alpestris (Jacq.) A. Löve: meadows, subalpine scrub; B1.
A. thyrsiflora (Fingerh.) A. et D. Löve: steppe meadow in B2.
Aconogonon alpinum (All.) Schur: meadows; B1, B2.
Bistorta officinalis Delarbre: alpine and subalpine meadows, subalpine scrub, tundras; B1.
B. vivipara (L.) Delarbre: alpine and subalpine meadows, subalpine scrub, tundras in B1; meadow on river terrace in B2.
Fallopia convolvulus (L.) A. Löve: stony steppes; B2.
Oxyria digyna (L.) Hill: boulder field in stream valley; B1.
Polygonum aviculare L. s.l.: roadside of country road and steppe in B2.
Rheum altaicum Losinsk.: rocks, stony steppes; B1, B2.

Limoniaceae (1/1).
Goniolimon speciosum (L.) Boiss.: stony steppe in B2.

Ericaceae (2/3).
Pyrola asarifolia Michx.: larch-birch-spruce forest in B2.
P. minor L.: bushy tundra with *Betula rotundifolia* in B1; stony river bank in B2.
Vaccinium vitis-idaea L.: bushy tundras with *Betula rotundifolia*; B1.

Polemoniaceae (1/1).
Polemonium caeruleum L.: subalpine meadows and scrub; B1.

Primulaceae (2/5).
Androsace maxima L.: stony steppes; B2.
A. septentrionalis L.: stony steppes; B2.
Primula algida Adams: alpine meadows, rocks; B1.
P. macrocalyx Bunge: meadows; B2.

P. nivalis Pall.: stream banks, riverine meadows and scrub; B1.

Salicaceae (2/12).

Populus tremula L.: edge of spruce-larch forest in B2.

Salix brayi Ledeb.: between boulder field and *Kobresia* alpine meadow in B1.

S. divaricata Pall.: subalpine scrub in B1 (*).

S. glauca L.: subalpine scrub, meadows; B1.

S. hastata L.: subalpine scrub in B1.

S. nummularia Andersson: stony tundra in B1 (*).

S. rectijulis Ledeb. ex Trautv.: alpine meadows, stream banks; B1.

S. rorida Laksch.: stony river bank in B2.

S. saposhnikovii A.K. Skvortsov: riverine scrub, wet meadows; B1.

S. taraikensis Kimura: forests, river banks; B2.

S. turczaninowii Laksch.: alpine meadows, tundras; B1.

S. viminalis L.: river banks; B2.

Violaceae (1/4).

Viola altaica Ker Gawl.: alpine meadows; B1.

V. arenaria DC.: steppe meadow in B2.

V. biflora L.: scree under rock in B1.

V. dissecta Ledeb.: stony steppe and meadow in B2.

Brassicaceae (10/16).

Arabis pendula L.: roadside of country road in B2.

Camelina microcarpa Andrz.: meadow in B2.

Cardamine bellidifolia L.: between boulder field and nival meadow in B1 (*).

C. macrophylla Willd.: meadow in stream valley in B1.

C. pratensis L.: stream bank in B1.

Descurainia sophia (L.) Webb ex Prantl: roadside of country road in B2.

Dontostemon micranthus (L.) C.A. Mey.: stony steppe in B2.

Draba cana Rydb.: stony trail in B1 (*).

D. nemorosa L.: meadows, steppes; B1, B2.

D. sibirica (Pall.) Thell.: meadow in B2.

D. subamplexicaulis C.A. Mey.: *Kobresia* alpine meadow and stony trail in B1 (*).

Erysimum marschallianum Andrz.: small-stone scree in B2.

Lepidium densiflorum Schrader: roadside of country road in B2.

Sisymbrium heteromallum C.A. Mey.: stony steppe in B2.

S. loeselii L.: roadside of country road in B2.

Thlaspi arvense L.: steppe meadow in B2.

Urticaceae (1/2).

Urtica cannabina L.: at boulder base on steppe slope in B2.

U. dioica L.: boulder fields, meadows; B1, B2.

Euphorbiaceae (1/1).

Euphorbia borealis Baikov: steppe meadow in B2.

Crassulaceae (4/6).

Aizopsis hybrida (L.) Grylich: rocks, stony steppes, screes; B1, B2.

Hylotelephium ewersii (Ledeb.) H. Ohba: rock in B1.
Orostachys spinosa (L.) C.A. Mey.: rocks, stony steppes; B1, B2.
Rhodiola algida (Ledeb.) Fisch. et C.A. Mey.: stream banks, wet meadows; B1.
R. coccinea (Royle) Boriss.: stony tundras, rocks; B1.
R. rosea L.: meadows, scrub; B1.

Saxifragaceae (2/4).
Bergenia crassifolia (L.) Fritsch: boulder field in B1.
Saxifraga aestivalis Fisch. et C.A. Mey.: stream bank in B1.
S. hirculus L.: forb-grass-sedge bog in stream valley; B1.
S. sibirica L.: tundras, rocks, boulder fields; B1, B2.

Grossulariaceae (2/4).
Grossularia acicularis (Smith) Spach: boulder fields, stony steppes; B2.
Ribes altissimum Turcz. ex Pojark.: boulder fields; B2.
R. graveolens Bunge: boulder field in B1.
R. nigrum L.: at base of rock in B1.

Rosaceae (16/35).
Agrimonia pilosa Ledeb.: steppe meadow in B2.
Alchemilla dasyclada Juz.: meadows; B1 (*).
A. monticola Opiz: subalpine meadow in B1 (*).
Chamaerhodos erecta (L.) Bunge: stony steppes; B2.
Coluria geoides (Pall.) Ledeb.: stony steppe in B2.
Comarum palustre L.: wet meadow in B1.
Cotoneaster melanocarpus Fisch. ex Blytt: steppes, steppe meadows; B1, B2.
C. uniflorus Bunge: rock in B1.
Dasiphora fruticosa (L.) Rydb.: riverine scrub, meadows, boulder fields; B1.
Dryas oxyodonta Juz.: tundras, alpine meadows; B1.
Fragaria viridis Duchesne: steppes, steppe meadows; B2.
Geum aleppicum Jacq.: meadows; B2.
Potentilla acaulis L.: stony steppes; B2.
P. approximata Bunge: steppe on river terrace in B2.
P. asiatica (Th. Wolf) Juz.: meadows; B1.
P. bifurca L.: steppes, steppe meadows; B2.
P. canescens Besser: trail in B1 (*).
P. chrysantha Trevir: steppe meadow in B2.
P. conferta Bunge: steppe in B1 (*).
P. desertorum Bunge: boulder fields; B1, B2 (*).
P. gelida C.A. Mey.: meadows, tundras, scrub; B1.
P. longifolia Willd. ex Schlecht.: steppes, steppe meadows; B2.
P. multifida L.: meadows; B1, B2.
P. nivea L.: meadows, tundras; B1.
P. pensylvanica L.: meadows; B1, B2 (*).
P. sericea L.: stony steppes, rocks; B1, B2 (*).
Rosa acicularis Lindl.: forests, forest edges, scrub; B2.

R. oxyacantha M. Bieb.: boulder field in B1.
Rubus matsumuranus H. Lév. et Vaniot: boulder fields, meadows; B1, B2.
Sanguisorba alpina Bunge: meadows, subalpine scrub, stream banks; B1.
S. officinalis L.: steppe meadow in B2.
Sibbaldia procumbens L.: alpine meadow in B1.
Spiraea alpina Pall.: subalpine scrub, alpine and subalpine meadows, bushy tundras with *Betula rotundifolia*, boulder fields in B1; forest in B2.
S. chamaedryfolia L.: larch-birch-spruce forest in B2.
S. flexuosa Fisch. ex Cambess.: stony steppes, steppe meadows, boulder fields; B1, B2.

Onagraceae (1/2).
Chamaenerion angustifolium (L.) Holub: meadows, boulder fields, subalpine scrub, river banks; B1, B2.
C. latifolium (L.) Holub: river and stream banks; B1, B2.

Fabaceae (9/21).
Astragalus austrosibiricus Schischk.: meadows, steppes, river and stream banks; B1, B2 (*).
A. frigidus (L.) A. Gray: meadows, riverine scrub, river and stream banks; B1, B2.
A. schanginianus Pall.: stony steppe in B2.
Caragana pygmaea (L.) DC.: stony steppes; B2.
Hedysarum austrosibiricum B. Fedtsch.: alpine and subalpine meadows, dryad tundras; B1.
Lathyrus humilis (Ser.) Fisch. ex Spreng.: steppe meadow in B2.
L. pratensis L.: steppe meadow in B2.
Lupinaster eximium (Steph. ex DC.) C. Presl: tundras with *Dryas* and *Kobresia*, meadows, riverine sediments; B1.
L. pentaphyllus Moench: meadows; B1, B2.
Medicago falcata L.: steppes, steppe meadows; B2.
Oxytropis alpina Bunge: tundras with *Dryas* and *Kobresia*; B1 (*).
O. altaica (Pall.) Pers.: alpine meadows; B1.
O. pilosa (L.) DC.: steppe meadow in B2.
O. recognita Bunge.: meadows, tundras with *Dryas* and *Kobresia*; B1, B2 (*).
O. songorica (Pall.) DC.: stony steppe in B2 (*).
O. strobilacea Bunge.: meadow in B1 (*).
Trifolium pratense L.: steppe meadow in B2.
T. repens L.: meadows, trails; B1, B2.
Vicia costata Ledeb.: stony steppe in B2.
V. cracca L.: steppe meadow in B2.
V. megalotropis Ledeb.: meadow in B2 (*).

Polygalaceae (1/1).
Polygala hybrida DC.: meadow patch in boulder field; B1.

Geraniaceae (1/4).
Geranium albiflorum Ledeb.: meadows, subalpine scrub; B1.

G. pratense L.: meadows; B2.
G. pseudosibiricum J. Mayer.: riverine scrub in B1.
G. transbaicalicum Serg.: steppe meadow in B1 (*).

Parnassiaceae (1/1).
Parnassia palustris L.: river and stream banks; B1, B2.

Santalaceae (1/2).
Thesium refractum C.A. Mey.: stony steppe in B2.
Th. repens Ledeb.: meadow patch in boulder field; B1.

Sambucaceae (1/1).
Sambucus sibirica Nakai: forests, forest edges, boulder fields; B2.

Adoxaceae (1/1).
Adoxa moschatellina L.: larch-birch-spruce forest in B2.

Caprifoliaceae (2/4).
Linnaea borealis L.: forests; B2.
Lonicera altaica Pall. ex DC.: forests, meadows, boulder fields; B1, B2.
L. hispida Pall. ex Schult.: boulder field in B1.
L. microphylla Willd. ex Schult.: stony steppes, boulder fields; B2.

Valerianaceae (1/1).
Patrinia sibirica (L.) Juss.: tundras, alpine meadows; B1.

Apiaceae (11/12).
Aegopodium alpestre Ledeb.: meadows, forests; B1, B2.
Angelica decurrens (Ledeb.) B. Fedtsch.: river and stream banks, riverine scrub and meadows; B1, B2.
Aulacospermum anomalum (Ledeb.) Ledeb.: steppe meadow in B1.
Bupleurum multinerve DC.: steppe meadows; B1, B2.
Carum carvi L.: steppe meadow in B2.
Hansenia mongholica Turcz.: boulder field in B1 (*).
Pachypleurum alpinum Ledeb.: alpine meadows, tundras; B1.
Peucedanum vaginatum Ledeb.: bushy tundras with *Betula rotundifolia*, meadows; B1, B2 (*).
Pleurospermum uralense Hoffm.: subalpine meadows and scrub; B1.
Schulzia crinita (Pall.) Spreng.: alpine meadows, tundras; B1.
Seseli buchtormense (Spreng.) W.D.J. Koch: stony steppes, rocks; B2 (*).
S. condensatum (L.) Rchb. f.: meadows; B1.

Campanulaceae (2/4).
Adenophora liliifolia (L.) A. DC.: meadows, boulder fields, scrub; B2 (*).
Campanula altaica Ledeb.: meadow in B2.
C. glomerata L.: meadows; B1, B2.
C. sibirica L.: stony steppe in B2.

Asteraceae (23/42).
Achillea asiatica Serg.: steppes, meadows; B1, B2.
Antennaria dioica (L.) Gaertn.: steppes, short herb meadows, bushy tundras with *Betula rotundifolia*; B1, B2.

Artemisia dracunculus L.: steppes, steppe meadows; B2.
A. frigida Willd.: steppes; B2.
A. laciniata Willd.: meadows; B2 (*).
A. macrantha Ledeb.: meadow at edge of larch-spruce forest in B2 (*).
A. phaeolepis Krasch.: alpine meadows; B1 (*).
A. santolinifolia Turcz. ex Besser: stony steppes; B2.
A. scoparia Waldst. et Kit.: steppes; B2.
A. sieversiana Willd.: steppes, disturbed habitats; B2.
A. vulgaris L.: steppe meadow in B2.
Aster alpinus L.: meadows, steppes; B1, B2.
Carduus nutans L.: steppe meadow in B2.
Cirsium komarovii Schischk.: scrub at edge of boulder field in B2.
Crepis chrysantha (Ledeb.) Turcz.: tundras, alpine meadows; B1.
C. tectorum L.: steppe meadow in B2.
Erigeron acris L.: steppes, meadows; B1, B2 (*).
E. flaccidus (Bunge) Botsch.: alpine meadow in B1.
E. lonchophyllus Hook.: stony trail in B1 (*).
E. politus Fr.: steppe meadow in B2.
E. uniflorus L. subsp. *eriocalyx* (Ledeb.) A. et D. Löve: tundras, alpine meadows; B1.
Heteropappus altaicus (Willd.) Novopokr.: steppes, steppe meadows; B2.
Jacobaea nemorensis (L.) E. Wiebe: forests, meadows, boulder fields; B1, B2.
Ligularia altaica DC.: meadows; B1.
Packera heterophylla (Fisch.) E. Wiebe.: dryad tundra in B1.
Ptarmica ledebouri (Heimerl) Serg.: subalpine and alpine meadows; B1.
Saussurea frolovii Ledeb.: subalpine meadow in B1.
S. krylovii Schischk. et Serg.: steppe-meadow patch among rocks and screes in B1.
S. latifolia Ledeb.: subalpine meadow in B1.
S. parviflora (Poir.) DC.: alpine meadow in B1.
S. schanginiana (Wydler) Fisch. ex Serg.: *Kobresia* alpine meadow in B1 (*).
Scorzonera radiata Fisch.: meadows; B1.
Solidago virgaurea L.: meadows; B1.
Tanacetum vulgare L. subsp. *boreale* (Fisch. ex DC.) A. et D. Löve: meadow at edge of spruce-larch forest in B2.
Taraxacum altaicum Schischk.: boulder field in stream valley in B1.
T. glabrum DC.: alpine meadow in B1.
T. officinale F.H. Wigg.: meadow along trail in B1 (*).
Tephroseris turczaninovii (DC.) Holub: between boulder field and bushy tundra with *Betula rotundifolia* in B1.
Tragopogon orientalis L.: steppe meadow in B2.
Tripleurospermum ambiguum (Ledeb.) Franch. et Sav.: meadows, riverine pebble; B1.

Trommsdorffia maculata (L.) Bernh.: subalpine open forest with *Larix sibirica* and *Pinus sibirica* at timberline in B1.
Youngia tenuicaulis (Babc. et Stebbins) Czerep.: rocks; B2.

Rubiaceae (1/6).
Galium boreale L.: forests, meadows, scrub, boulder fields; B1, B2.
G. densiflorum Ledeb.: meadows; B1.
G. mollugo L.: steppe meadow in B2 (*).
G. ruthenicum Willd.: steppe meadow in B2 (*).
G. uliginosum L.: wet meadow in B1.
G. vaillantii DC.: rocks, boulder fields; B2 (*).

Gentianaceae (4/5).
Calathiana uniflora (Georgi) Holub: meadow patch in boulder field; B1.
Ciminalis grandiflora (Laxm.) Zuev: alpine meadows, tundras; B1.
Dasystephana algida (Pall.) Borkh.: alpine meadows, tundras; B1.
D. macrophylla (Pall.) Zuev: steppe meadow in B2.
Swertia obtusa Ledeb.: alpine and subalpine meadows, subalpine scrub; B1.

Cuscutaceae (1/1).
Cuscuta europaea L.: stony steppe in B2 (*).

Boraginaceae (2/3).
Lappula intermedia (Ledeb.) Popov: stony steppes; B2 (*).
L. redowskii (Hornem.) Greene: stony steppe in B2 (*).
Myosotis imitata Serg.: meadows; B1, B2.

Scrophulariaceae (7/18).
Euphrasia altaica Serg.: alpine meadows; B1.
E. pectinata Ten.: stony steppes, steppe meadows; B2 (*).
Lagotis integrifolia (Willd.) Schischk.: alpine meadows, subalpine scrub, stream banks; B1.
Linaria acutiloba Fisch. ex Rchb.: steppe meadow in B2.
L. altaica Fisch. ex Ledeb.: stony steppe in B2.
Pedicularis amoena Adams ex Steven: alpine meadows, tundras; B1. (*).
P. anthemifolia Fisch. ex Colla: subalpine meadow in B1 (*).
P. compacta Stephan ex Willd.: alpine meadows; B1.
P. lasiostachys Bunge: *Kobresia* alpine meadows; B1 (*).
P. oederi Vahl: alpine meadows, tundras; B1.
P. proboscidea Gaudin: subalpine meadows and scrub; B1.
P. tristis L.: alpine meadow in B1.
Rhinanthus aestivalis (N.W. Zinger) Schischk. et Serg.: short herb meadow in floodplain; B2.
Scrophularia incisa Weinm.: screes, boulder fields; B2.
Veronica densiflora Ledeb.: meadows, tundras; B1.
V. longifolia L.: meadows; B1, B2.
V. pinnata L.: stony steppe in B2.

V. porphyriana Pavlov: steppes, steppe meadows; B1, B2.

Orobanchaceae (1/1).

Orobanche coerulescens Stephan: stony steppe with *Potentilla acaulis* and *Artemisia frigida* in B2.

Plantaginaceae (1/1).

Plantago depressa Willd.: stony steppe with *Potentilla acaulis* and *Artemisia frigida* in B2.

Lamiaceae (6/9).

Dracocephalum grandiflorum L.: alpine meadows; B1.

D. nutans L.: steppe in B2.

D. peregrinum L.: stony steppes; B2.

Lamium album L.: meadows, scrub; B1, B2.

Leonurus glaucescens Bunge: boulder fields, scrub; B2 (*).

Nepeta sibirica L.: river banks, roadsides of country road, steppe meadows; B2.

Phlomoides alpina (Pall.) Adylov, Kamelin et Machm.: meadows; B1 (*).

Ph. tuberosa (L.) Moench: stony steppes, steppe meadows; B2.

Thymus mongolicus (Ronniger) Ronniger: alpine steppe meadows, stony tundras; B1 (*).

Melanthiaceae (1/1).

Veratrum lobelianum Bernh.: meadows, scrub; B1.

Liliaceae (2/2).

Erythronium sibiricum (Fisch. et C.A. Mey.) Krylov: meadows; B1.

Lilium pilosiusculum (Freyn) Miscz.: forests, meadows; B2.

Orchidaceae (1/1).

Goodyera repens (L.) R. Br.: larch-birch-spruce forest in B2.

Iridaceae (1/3).

Iris bloudowii Ledeb.: meadows, subalpine open forests; B1.

I. glaucescens Bunge: stony steppes, screes; B2 (*).

I. ruthenica Ker Gawl.: meadows; B2.

Alliaceae (1/11).

Allium altaicum Pall.: boulder fields, rocks; B1, B2.

A. platyspathum Schrenk subsp. *amblyophyllum* (Kar. et Kir.) N. Friesen: alpine meadow in stream valley; B1 (*).

A. amphibolum Ledeb.: *Kobresia* alpine meadows, rocks, boulder fields; B1 (*).

A. azutavicum Kotuchov: short herb meadow in flloodplain; B2 (*).

A. bellulum Proch.: stony steppe in B2 (*).

A. flavidum Ledeb.: alpine meadow in B1.

A. nutans L.: roadside of country road in B2.

A. ramosum L.: stony steppe in B2 (*).

A. rubens Schrad. ex Willd.: stony steppe in B2.

A. schoenoprasum L.: stream banks, wet meadows; B1 (*).

A. strictum Schrad.: stony steppes, steppe meadows, boulder fields; B1, B2 (*).

Juncaceae (1/2).

Luzula multiflora (Ehrh.) Lej. subsp *sibirica* V.I. Krecz.: alpine meadows; B1.

L. spicata (L.) DC.: *Kobresia* alpine meadow in B1.

Cyperaceae (3/18).

Carex aterrima Hoppe: subalpine and alpine meadows, subalpine scrub; B1.

C. brunnescens (Pers.) Poir.: riverine pebble and stream banks; B1.

C. cespitosa L.: stream banks; B1.

C. curaica Kunth: steppe meadow in B1.

C. duriuscula C.A. Mey.: stony steppes, riverine pebble; B2.

C. eleusinoides Turcz. ex Kunth: riverine pebble and stream banks; B1.

C. korshinskyi Kom.: stony steppes; B2.

C. ledebouriana C.A. Mey. ex Trev.: dryad tundras, *Kobresia* alpine meadows; B1.

C. melanocephala Turcz.: wet meadows; B1.

C. orbicularis Boott subsp. *altaica* (Gorodkov) T.V. Egorova: riverine bog with *Carex* and *Eriophorum* in B1.

C. pamirica (O. Fedtsch.) O. et B. Fedtsch.: bogs, stream banks; B1.

C. pediformis C.A. Mey.: stony steppes, steppe meadows; B1, B2.

C. rupestris All.: forb tundra with *Dryas* and *Kobresia* in B1.

C. tristis M. Bieb. subsp. *stenocarpa* (Turcz. ex V.I. Krecz.) T.V. Egorova: meadows, tundras; B1.

Eriophorum angustifolium Honck.: wet alpine meadow in B1.

E. humile Turcz. ex Steud.: wet alpine meadow in B1.

E. scheuchzeri Hoppe: riverine bog with *Carex* and *Eriophorum* in B1.

Kobresia myosuroides (Vill.) Fiori: tundras, alpine meadows; B1.

Poaceae (21/46).

Achnatherum sibiricum (L.) Keng ex Tzvelev: stony steppes; B2.

A. splendens (Trin.) Nevski: stony steppe in B2.

Agropyron cristatum (L.) P. Beauv.: steppes; B2 (*).

A. pumilum P. Candargy: forb-grass meadow in B2 (*).

Agrostis gigantea Roth: alpine meadow in B1.

A. syreitschikowii P.A. Smirn.: steppes, meadows, tundras with *Dryas* and *Kobresia*; B1, B2 (*).

Alopecurus aequalis Sobol.: wet place on country road in B1.

A. pratensis L.: meadows; B1, B2.

Anthoxanthum alpinum A. et D. Löve: subalpine and alpine meadows; B1.

Avenula hookeri (Scribn.) Holub: steppe meadows; B1.

A. pubescens (Huds.) Dumort.: forb-grass steppe meadow in B2.

Bromopsis altaica Peschkova: meadows; B1, B2.

Calamagrostis epigeios (L.) Roth: steppes; B2.

C. pavlovii Roshev.: larch-birch-spruce forest in B2.

C. purpurea (Trin.) Trin.: meadows, boulder fields, subalpine scrub; B1, B2.

Deschampsia altaica (Schischkin) O.D. Nikif.: subalpine and alpine meadows; B1.

Elymus confusus (Roshev.) Tzvelev: meadow in B1 (*).
E. gmelinii (Ledeb.) Tzvelev: steppes, steppe meadows; B2 (*).
E. sibiricus L.: forb-grass steppe meadow in B2.
Elytrigia repens (L.) Nevski: forb-grass steppe meadow and stony river bank in B2.
Festuca altaica Trin.: alpine meadows; B1.
F. kryloviana Reverd.: subalpine and alpine meadows; B1 (*).
F. ovina L. subsp. *sphagnicola* (B. Keller) Tzvelev: bushy tundras with *Betula rotundifolia*, dryad tundras, alpine meadows; B1 (*).
F. rubra L.: wet meadows; B1.
Helictotrichon altaicum Tzvelev: steppes, steppe meadows; B1, B2 (*).
Hierochloë alpina (Sw.) Roem. et Schult.: stony tundra in B1.
H. sibirica (Tzvelev) Czerep.: alpine meadow in B1 (*).
Koeleria altaica (Domin) Krylov: forb-grass steppe meadow in B1 (*).
K. cristata (L.) Pers.: stony steppe in B2.
Leymus angustus (Trin.) Pilg.: stony steppe in B2 (*).
L. dasystachys (Trin.) Pilg.: small-stone scree in B2 (*).
Phleum alpinum L.: alpine and subalpine meadows, stream banks; B1.
Ph. phleoides (L.) Karst.: steppes, steppe meadows; B2.
Poa alpigena (Blytt) Lindm.: boulder field in stream valley; B1 (*).
P. alpina L.: meadow in B1.
P. argunensis Roshev.: stony steppe in B2 (*).
P. attenuata Trin.: partially swarded rocks in B1.
P. botryoides (Trin. ex Griseb.) Kom.: stony steppes; B2 (*).
P. glauca Vahl: steppe meadow in B1 (*).
P. pratensis L.: steppes, steppe meadows; B2.
P. sibirica Roshev.: meadows; B1.
P. urssulensis Trin.: stony steppes, rocks, boulder fields; B2.
Psathyrostachys juncea (Fisch.) Nevski: stony steppes; B2.
Stipa krylovii Roshev.: stony steppes; B2.
Trisetum altaicum Roshev.: alpine meadow in stream valley; B1.
T. mongolicum (Hultén) Peschkova: alpine meadow in stream valley; B1.

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Huperziaceae (1/1).
Huperzia selago (L.) Bernh. ex Schrank et Mart.: rock in C1.
Equisetaceae (1/4).
Equisetum arvense L.: wet meadows, bogs, scrub, river and stream banks; C1, C2 (*).
E. fluviatile L.: boggy river bank in C1.
E. hyemale L.: *Salix* and *Betula rotundifolia* scrub in C1 (*).
E. sylvaticum L.: forests; C2.
Aspleniaceae (1/1).
Asplenium septentrionale (L.) Hoffm.: southern rock in C2 (*).

Athyriaceae (2/2).

Athyrium filix-femina (L.) Roth: forest meadow in C2.

Cystopteris fragilis (L.) Bernh.: rocks; C1, C2.

Woodsiaceae (1/1).

Woodsia asiatica Schmakov et Kiselev: rocks; C1.

Pinaceae (4/4).

Abies sibirica Ledeb.: forests; C1, C2.

Larix sibirica Ledeb.: forests, open forests, *Betula rotundifolia* scrub; C1, C2.

Picea obovata Ledeb.: forests, open forests; C1, C2.

Pinus sibirica Du Tour: forests, open forests, *Betula rotundifolia* scrub, rocks; C1, C2.

Cupressaceae (1/2).

Juniperus pseudosabina Fisch. et C.A. Mey.: rocks, boulder fields; C1.

J. sibirica Burgsd.: rocks, boulder fields, scrub; C1.

Berberidaceae (1/1).

Berberis sibirica Pall.: rocks, screes, stony steppes; C1, C2.

Ranunculaceae (12/21).

Aconitum anthoroideum DC.: steppe meadow in C2.

A. krylovii Steinb.: subalpine meadows and scrub; C1.

A. leucostomum Vorosch.: forests, meadows, scrub; C1, C2.

A. volubile Pall. ex Koelle: forests, meadows; C2.

Anemonastrum crinitum (Juz.) Holub: forb-sedge-fescue tundra in C1.

Aquilegia glandulosa Fisch. ex Link: alpine and subalpine meadows, tundras, scrub; C1.

Atragene sibirica L.: forests, boulder fields; C1, C2.

Batrachium trichophyllum (Chaix) F.W. Schultz: lake in C1 (*).

Callianthemum sajanense (Regel) Witasek: alpine meadow in C1.

Caltha palustris L.: river and stream banks, bogs, boggy scrub, wet meadows; C1, C2.

Delphinium elatum L.: meadows, forests; C1, C2.

D. inconspicuum Serg.: alpine meadow at base of boulder field in C1 (*).

Pulsatilla nuttalliana (DC.) Spreng.: meadows in C2 (*); forb-bilberry heath in C1.

Ranunculus altaicus Laxm. s. str.: alpine and nival meadows, tundras; C1.

R. altaicus Laxm. subsp. *sulphureus* (Sol.) Kadota: rock in C1 (*).

R. grandifolius C.A. Mey.: meadows, subalpine scrub; C1.

R. polyanthemos L.: steppe meadow in C2.

R. repens L.: river and stream banks, bogs, wet meadows; C1, C2.

R. submarginatus Ovcz.: meadow along roadside in C2 (*).

Thalictrum minus L.: meadows; C1, C2.

Trollius altaicus C.A. Mey.: meadows; C1, C2 (*).

Papaveraceae (1/1).

Papaver pseudocanescens Popov: alpine meadows, tundras; C1 (*).

Fumariaceae (1/1).

Fumaria schleicheri Soy.-Will.: scrub in C2 (*).

Paeoniaceae (1/2).

Paeonia anomala L.: forest in C2.

P. hybrida Pall.: scrub on scree in C2.

Betulaceae (1/2).

Betula pendula Roth: valley forests; C2.

B. rotundifolia Spach: bushy tundras, subalpine scrub; C1.

Caryophyllaceae (11/20).

Arenaria serpyllifolia L.: steppe meadow in C2 (*).

Cerastium davuricum Fisch. ex Spreng.: meadows, forests, open forests; C1, C2.

C. holosteoides Fries: meadows; C1, C2 (*).

C. pauciflorum Steven ex Ser.: forests, subalpine meadows, C1, C2.

C. pusillum Ser.: forb-sedge-fescue tundra in C1.

Dianthus superbus L.: meadows; C1, C2.

Dichodon cerastoides (L.) Rchb.: wet meadows, tundras; C1.

Gastrolychnis apetala (L.) Tolm. et Kozhanch.: forb-sedge-fescue tundra in C1.

G. tristis (Bunge) Czerep.: rock in C1.

Gypsophila altissima L.: stony steppe in C2.

Melandrium album (Mill.) Garcke: meadows; C2.

Minuartia biflora (L.) Schinz et Thell.: tundras, alpine meadows; C1.

M. kryloviana Schischk.: rock in C1 (*).

Oberna behen (L.) Ikonn.: meadows; C1, C2.

Silene amoena L.: steppe meadow in C2.

S. graminifolia Otth: alpine meadows, tundras, heaths, rocks; C1.

Stellaria bungeana Fenzl: forests; C2.

S. graminea L.: meadow in C2 (*).

S. irrigua Bunge: rock in C1.

S. palustris Retz.: river and stream banks, bogs; C1 (*).

Chenopodiaceae (1/1).

Chenopodium album L.: steppe meadow in C2.

Polygonaceae (8/11).

Acetosa alpestris (Jacq.) A. Löve: subalpine meadows; C1.

A. thyrsiflora (Fingerh.) A. et D. Löve: steppes, steppe meadows; C2.

Aconogonon alpinum (All.) Schur.: meadows, steppes; C1, C2.

Bistorta officinalis Delarbre: alpine and subalpine meadows, tundras; C1.

B. vivipara (L.) Delarbre: alpine and subalpine meadows, tundras; C1.

Fallopia convolvulus (L.) A. Löve: steppe meadow in C2.

Oxyria digyna (L.) Hill: rock in C1.

Polygonum aviculare L. s.l.: country road and steppe meadow in C2 (*).

Rheum altaicum Losinsk.: rock in C1.

Rumex aquaticus L.: stream banks; C2.

R. confertus Willd.: steppe meadow in C2.

Hypericaceae (1/2).

Hypericum hirsutum L.: steppe meadow in C2.

H. perforatum L.: steppes, steppe meadows; C2.

Ericaceae (2/3).

Pyrola minor L.: subalpine scrub and open forests, bushy tundras with *Betula rotundifolia*; C1.

Vaccinium myrtillus L.: heaths, boulder fields, subalpine scrub; C1.

V. vitis-idaea L.: heaths, boulder fields, subalpine scrub; C1.

Polemoniaceae (1/1).

Polemonium caeruleum L.: meadow in C2.

Primulaceae (2/6).

Androsace filiformis Retz.: wet section of country road in C2.

A. septentrionalis L.: stony steppes, steppe meadows; C2.

Primula algida Adams: alpine meadow in C1.

P. macrocalyx Bunge: forests, meadows; C2.

P. matthioli (L.) V.A. Richt.: forb-*Bergenia*-bilberry heath at base of rock in C1.

P. nivalis Pall.: north-western rock in C1.

Salicaceae (2/13).

Populus tremula L.: aspen forests; C2.

Salix alatavica Kar. et Kir. ex Stschegl.: scree in C1 (*).

S. caprea L.: valley forests, meadows; C2.

S. divaricata Pall.: river and stream banks, riverine scrub; C1 (*).

S. glauca L.: subalpine scrub, tundras; C1.

S. hastata L.: river and stream banks, riverine scrub; C1.

S. pentandra L.: birch-willow forest in stream valley; C2 (*).

S. pyrolifolia Ledeb.: fir-birch-spruce valley forest in C2.

S. rectijulis Ledeb. ex Trautv.: forb-sedge-fescue tundra in C1.

S. taraikensis Kimura: valley forests; C2.

S. turczaninowii Laksch.: low bush tundra in C1.

S. vestita Pursh: scree in C1.

S. viminalis L.: river and stream banks, riverine scrub; C2.

Violaceae (1/5).

Viola altaica Ker Gawl.: alpine and subalpine meadows, tundras; C1.

V. arenaria DC.: meadow with shrubs in C2 (*).

V. biflora L.: meadows, forests, boulder fields, scrub; C1, C2.

V. disjuncta W. Becker: subalpine and forest meadows; C1, C2 (*).

V. hirta L.: meadows; C2 (*).

Brassicaceae (7/10).

Arabis glabra (L.) Bernh.: steppes, meadows; C2 (*).

Barbarea arcuata (Opiz ex J. et C. Presl) Rchb.: steppe meadow in C1.

Bunias orientalis L.: meadow along country road in C2.

Cardamine macrophylla Willd.: river and stream banks, wet meadows, boggy forests; C1, C2.

C. pratensis L.: boggy river bank in C1.
Draba cana Rydb.: rocks; C1 (*).
D. fladnizensis Wulfen: rock in C1 (*).
D. nemorosa L.: stony steppe in C2.
Hesperis sibirica L.: forest meadow in C2.
Thlaspi arvense L.: steppes, meadows; C2.

Urticaceae (1/1).
Urtica dioica L.: forests, meadows; C2.

Euphorbiaceae (1/3).
Euphorbia alpina Ledeb.: subalpine meadows and scrub, screes; C1 (*).
E. borealis Baikov: meadow with shrubs in C2.
E. macrorhiza Ledeb.: stony steppe in C2 (*).

Crassulaceae (4/4).
Aizopsis hybrida (L.) Grylich: stony steppes, rocks; C2.
Hylotelephium ewersii (Ledeb.) H. Ohba: rock in C1.
Orostachys spinosa (L.) C.A. Mey.: stony steppes, rocks; C1, C2.
Rhodiola rosea L.: meadows, scrub, river and stream banks; C1.

Saxifragaceae (3/4).
Bergenia crassifolia (L.) Fritsch: rocks, screes, heaths, boulder fields; C1.
Chrysosplenium sibiricum (Ser. ex DC.) A.P. Khokhr.: river bank in C1 (*).
Saxifraga aestivalis Fisch. et C.A. Mey.: river and stream banks, wet meadows, tundras; C1, C2.
S. sibirica L.: rock in C1.

Grossulariaceae (2/4).
Grossularia acicularis (Smith) Spach: scree in C2.
Ribes atropurpureum C.A. Mey.: forests, forest meadows; C2 (*).
R. glabellum (Trautv. et C.A. Mey.) Hedl.: subalpine open forest with larch and siberian pine in C1 (*).
R. nigrum L.: forests, boulder fields, riverine scrub; C1, C2.

Rosaceae (17/32).
Agrimonia pilosa Ledeb.: steppe meadows; C2.
Alchemilla hirsuticaulis H. Lindb.: steppe meadow in C2 (*).
A. krylovii Juz.: river bank in C1 (*).
A. sibirica Zämelis: steppe meadow in C1 (*).
Comarum palustre L.: boggy banks; C1.
Cotoneaster melanocarpus Fisch. ex Blytt: steppes, forests, rocks, boulder fields, screes; C2.
C. uniflorus Bunge: meadows, rocks, boulder fields, screes; C1, C2.
Crataegus sanguinea Pall.: scrub at base of rock in C2.
Dasiphora fruticosa (L.) Rydb.: riverine scrub; C1.
Filipendula ulmaria (L.) Maxim.: meadows, forests; C2.

Fragaria vesca L.: forests, scrub; C2.
F. viridis Duchesne: steppes, steppe meadows; C2.
Geum aleppicum Jacq.: meadows, forests; C2.
G. rivale L.: river and stream banks, bogs, wet meadows and forests; C1, C2.
Padus avium Mill.: meadows, forests; C2.
Potentilla anserina L.: wet section of country road in C2.
P. argentea L.: steppe meadow in C2.
P. chrysantha Trevir: meadows, steppes; C2.
P. gelida C.A. Mey.: sedge-fescue tundra in C1.
P. nivea L.: alpine meadows, tundras, rocks; C1.
P. sericea L.: rocks; C1 (*).
Rosa acicularis Lindl.: forests, meadows, scrub; C2.
R. spinosissima L.: steppes, steppe meadows, scrub; C2.
Rubus idaeus L.: forests, forest meadows, scrub; C2.
R. matsumuranus H. Lév. et Vaniot: boulder field in C1.
R. saxatilis L.: meadows; C1, C2.
Sanguisorba alpina Bunge: wet meadows, bogs, river and stream banks; C1.
Sibbaldia procumbens L.: alpine meadows, tundras, heaths; C1.
Sorbus sibirica Hedl.: forests; C2.
Spiraea chamaedrypholia L.: fir-birch-spruce forest in C2.
S. flexuosa Fisch. ex Cambess.: rocks, screes; C1, C2.
S. media F. Schmidt: forests, meadows, steppes, scrub; C1, C2 (*).

Onagraceae (2/3).

Chamaenerion angustifolium (L.) Holub: meadows, scrub; C1, C2.
Epilobium alpinum L.: bogs, river and stream banks; C1.
E. palustre L.: bog at intersection of stream and country road in C2.

Fabaceae (8/15).

Hedysarum austrosibiricum B. Fedtsch.: alpine meadows, tundras; C1.
Lathyrus gmelinii Fritsch: forests, meadows; C1, C2.
L. humilis (Ser.) Fisch. ex Spreng.: steppes, steppe meadows; C1, C2.
L. pratensis L.: meadows; C1, C2.
Lupinaster pentaphyllus Moench: meadows; C1, C2.
Medicago falcata L.: meadow along country road in C2.
M. lupulina L.: meadow along country road in C2.
Onobrychis arenaria (Kit.) DC.: steppe meadow in C2.
Oxytropis alpina Bunge: forb-grass-sedge-cowberry alpine heath in C1 (*).
O. altaica (Pall.) Pers.: alpine meadows, heaths; C1.
Trifolium pratense L.: meadows; C1, C2.
T. repens L.: trails, country roads; C1, C2.
Vicia cracca L.: steppes, steppe meadows, scrub; C1, C2 (*).
V. megalotropis Ledeb.: meadow in C2.

V. sepium L.: meadows, forests; C2.

Polygalaceae (1/1).

Polygala hybrida DC.: steppe meadows, steppes; C1, C2.

Oxalidaceae (1/1).

Oxalis acetosella L.: fir-spruce forest in C2.

Geraniaceae (1/2).

Geranium albiflorum Ledeb.: subalpine meadows and scrub, forests; C1, C2.

G. pratense L.: steppe meadows; C2.

Parnassiaceae (1/1).

Parnassia palustris L.: wet *Betula rotundifolia* scrub in C1.

Santalaceae (1/1).

Thesium repens Ledeb.: meadows, boulder fields; C1.

Sambucaceae (1/1).

Sambucus sibirica Nakai: large-stony scree at base of southern slope in C2.

Adoxaceae (1/1).

Adoxa moschatellina L.: fir-birch-spruce forest in C2.

Caprifoliaceae (1/2).

Lonicera altaica Pall. ex DC.: forests, meadows, subalpine scrub; C1, C2.

L. tatarica L.: meadows; C2.

Valerianaceae (1/1).

Valeriana dubia Bunge: steppe meadow in C1.

Dipsacaceae (1/1).

Scabiosa ochroleuca L.: steppes, steppe meadows; C2.

Apiaceae (13/15).

Aegopodium alpestre Ledeb.: forests, meadows; C1, C2.

Angelica decurrens (Ledeb.) B. Fedtsch.: river and stream banks, bogs; C1, C2.

A. sylvestris L.: forests, meadows; C1, C2.

Anthriscus sylvestris (L.) Hoffm.: forests, meadows; C1, C2.

Aulacospermum anomalum (Ledeb.) Ledeb.: scrub on southern slope in C2.

Bupleurum longifolium L. subsp. *aureum* (Fisch. ex Hoffm.) Soó.: meadows, forests, scrub; C1, C2.

Carum carvi L.: partially swarded boulder field in C1; country road in C2.

Ferula soongarica Pall. ex Spreng.: scrub on southern slope in C2.

Heracleum dissectum Ledeb.: meadows, forests; C1, C2 (*).

Pachypleurum alpinum Ledeb.: alpine meadows, tundras; C1.

Peucedanum morisonii Besser ex Schult.: scrub on southern slope in C2.

Pleurospermum uralense Hoffm.: meadow patch in subalpine scrub; C1.

Schulzia crinita (Pall.) Spreng.: alpine and subalpine meadows, tundras; C1.

Seseli buchtormense (Spreng.) W.D.J. Koch: stony steppes, steppe meadows; C2.

S. condensatum (L.) Rchb. f.: meadows, scrub; C1.

Campanulaceae (1/2).

Campanula altaica Ledeb.: steppe meadow in C2.

C. glomerata L.: meadows; C1, C2.

Asteraceae (31/49).

Achillea asiatica Serg.: steppes, steppe meadows; C1, C2.
Alfredia cernua (L.) Cass.: meadows; C2.
Antennaria dioica (L.) Gaertn.: herb heaths, short herb meadows, tundras; C1.
Arctium tomentosum Mill.: meadows, roadsides of country road; C2.
Artemisia commutata Besser: stony steppe in C2.
A. dracunculus L.: stony steppe in C2.
A. sericea Weber ex Stechm.: steppes, steppe meadows; C2.
A. vulgaris L.: meadows; C2.
Aster alpinus L.: meadows, steppes; C1, C2.
Bidens tripartita L.: bog at intersection of stream and country road in C2.
Cacalia hastata L.: forests; C2.
Carduus crispus L.: meadows, roadsides of trails and country road; C2.
Carlina biebersteinii Bernh. ex Hornem.: steppe meadows; C2.
Cirsium helenioides (L.) Hill: meadows, forests; C1, C2.
C. serratuloides (L.) Hill: steppe meadows; C2.
C. setosum (Willd.) Besser: meadow along country road in C2.
Crepis chrysantha (Ledeb.) Turcz.: alpine meadows, tundras; C1.
C. lyrata (L.) Froel.: meadows, forests; C1, C2.
C. sibirica L.: meadows, forests; C1, C2.
Erigeron altaicus Popov: meadows; C1.
E. politus Fr.: meadows; C1, C2.
E. uniflorus L. subsp. *eriocalyx* (Ledeb.) A. et D. Löve.: alpine meadows, tundras; C1.
Fornicium carthamoides (Willd.) Kamelin: subalpine meadows; C1.
Galatella angustissima (Tausch) Novopokr.: scrub on southern slope in C2.
Gnaphalium norvegicum Gunnerus: meadows, subalpine scrub, tundras, heaths; C1.
Hieracium korshinskyi Zahn: meadows, heaths; C1.
H. krylovii Nevski ex Schljakov: meadows, open forests; C1, C2.
H. robustum Fr.: meadow along country road in C2 (*).
H. umbellatum L.: steppes, steppe meadows; C2 (*).
Jacobaea nemorensis (L.) E. Wiebe: forests, meadows, boulder fields, screes; C1, C2.
J. vulgaris Gaertn.: steppes, steppe meadows; C2.
Lepidotheca suaveolens (Pursh) Nutt.: trails and country roads; C2.
Ligularia altaica DC.: meadows; C1, C2.
Picris hieracioides L.: meadow along country road in C2 (*).
Pilosella altaica (Nägeli et Peter) Schljakov: meadows; C1 (*).
Ptarmica impatiens (L.) DC.: meadows; C1.
Pyrethrum alatavicum (Herder) O. et B. Fedtsch. subsp. *krylovianum* (Krasch.) Boldyreva: boulder field in C1.
Saussurea frolovii Ledeb.: meadows; C1.
S. krylovii Schischk. et Serg.: alpine meadow at base of boulder field in C1.
S. latifolia Ledeb.: meadows; C1, C2.
S. parviflora (Poir.) DC.: alpine meadow in C1.

Serratula coronata L.: meadow in C2 (*).
Solidago virgaurea L.: meadows; C1, C2.
Tanacetum tanacetoides (DC.) Tzvelev: stony steppe in C2.
T. vulgare L. s. str.: meadow in C2.
T. vulgare L. subsp. *boreale* (Fisch. ex DC.) A. et D. Löve: alpine meadow in C1.
Tragopogon orientalis L.: meadow in C2.
Tripleurospermum ambiguum (Ledeb.) Franch. et Sav.: meadows; C1.
Trommsdorffia maculata (L.) Bernh.: meadows; C1, C2.

Rubiaceae (1/5).
Galium boreale L.: meadows, forests, scrub; C1, C2.
G. densiflorum Ledeb.: alpine and subalpine meadows; C1.
G. ruthenicum Willd.: steppes, steppe meadows; C2.
G. uliginosum L.: wet meadows, river and stream banks; C1, C2 (*).
G. vaillantii DC.: scrub at base of rock in C2 (*).

Gentianaceae (3/5).
Ciminalis grandiflora (Laxm.) Zuev: alpine meadows, tundras, heaths; C1.
Dasystephana algida (Pall.) Borkh.: forb-sedge-fescue tundra in C1.
D. macrophylla (Pall.) Zuev: steppe meadow in C2.
D. septemfida (Pall.) Zuev: meadows; C1, C2.
Swertia obtusa Ledeb.: meadows, river and stream banks, scrub, tundras; C1.

Boraginaceae (3/5).
Echium vulgare L.: steppe meadows, steppes, disturbed habitats; C2.
Myosotis imitata Serg.: meadow patch in subalpine scrub; C1.
M. krylovii Serg.: forests; C1, C2.
M. palustris (L.) L.: wet meadows, bogs, forests, river and stream banks; C1, C2.
Pulmonaria mollis Wulfen ex Hornem.: forests, meadows; C1, C2.

Scrophulariaceae (7/18).
Euphrasia pectinata Ten.: steppes, steppe meadows; C2 (*).
E. syreitschikovii Govor. ex Pavlov: meadows, subalpine scrub; C1 (*).
Lagotis integrifolia (Willd.) Schischk.: low bush tundra in C1.
Linaria acutiloba Fisch. ex Rchb.: steppe meadow in C2 (*).
L. vulgaris Mill.: forb-grass meadow along country road in C2 (*).
Pedicularis compacta Stephan ex Willd.: meadows; C1.
P. lasiostachys Bunge: subalpine meadow in C1.
P. oederi Vahl: alpine meadows, tundras; C1.
P. proboscidea Gaudin: subalpine meadows; C1.
Rhinanthus aestivalis (N. Zinger) Schischk. et Serg.: steppes, steppe meadows; C2 (*).
Verbascum thapsus L.: stony steppe and roadside of country road in C2.
Veronica beccabunga L.: bog at intersection of stream and country road in C2 (*).
V. densiflora Ledeb.: meadows, tundras; C1.
V. krylovii Schischk.: steppe meadow in C2 (*).
V. longifolia L.: meadows, forests; C1, C2.
V. porphyriana Pavlov: steppes, steppe meadows; C1, C2.

V. serpyllifolia L.: boggy river bank in C1 (*).
V. verna L.: steppes, steppe meadows; C2 (*).

Plantaginaceae (1/2).
Plantago major L.: trails and country roads; C1, C2.
P. media L.: meadow in C1.

Callitrichaceae (1/1).
Callitriche palustris L.: wet place at intersection of trail and stream in C1.

Lamiaceae (12/15).
Dracocephalum grandiflorum L.: alpine and subalpine meadows, tundras, subalpine scrub; C1.
D. nutans L.: steppes, steppe meadows; C2.
D. ruyschiana L.: meadows; C2.
Galeopsis bifida Boenn.: meadows, forests; C2.
Glechoma hederacea L.: birch-willow forest in stream valley; C2 (*).
Lamium album L.: meadows, scrub; C1, C2.
Mentha arvensis L.: roadside of country road in C2 (*).
Nepeta nuda L.: meadow in C2 (*).
Origanum vulgare L.: meadows, meadow steppes; C2.
Phlomoides alpina (Pall.) Adylov, Kamelin et Machm.: subalpine meadows and scrub; C1.
Ph. tuberosa (L.) Moench: steppes, steppe meadows; C2.
Prunella vulgaris L.: country road in C1.
Scutellaria supina L.: steppes, steppe meadows, meadow patches in boulder fields; C1, C2.
Thymus mongolicus (Ronniger) Ronniger: south-western rock in C1 (*).
Ziziphora clinopodioides Lam.: stony steppe in C2.

Melanthiaceae (1/2).
Veratrum lobelianum Bernh.: meadows, scrub, valley forests; C1, C2.
V. nigrum L.: steppe meadows, scrub; C2.

Liliaceae (2/2).
Erythronium sibiricum (Fisch. et C.A. Mey.) Krylov: dwarf shrub heath, among forb-grass meadow and subalpine scrub; C1.
Lloydia serotina (L.) Rchb.: rock in C1.

Orchidaceae (1/1).
Dactylorhiza fuchsii (Druce) Soó.: meadows, scrub; C1 (*)

Iridaceae (1/2).
Iris bloudowii Ledeb.: steppe meadow in C1.
I. ruthenica Ker Gawl.: meadows; C1, C2.

Alliaceae (1/5).
Allium flavidum Ledeb.: alpine meadows, heaths; C1.
A. ledebourianum Schult. et Schult. f.: wet meadow along stream in C1.
A. nutans L.: steppe meadow in C2.
A. schoenoprasum L.: alpine meadow in C1.

A. strictum Schrad.: rock in C2.

Juncaceae (2/6).

Juncus bufonius L.: wet section of country road in C2 (*).

J. filiformis L.: bogs, wet meadows, river and stream banks; C1.

J. gerardii Loisel.: bog at intersection of stream and country road in C2 (*).

Luzula confusa Lindeb.: sedge-cowberry alpine heath in C1.

Luzula multiflora (Ehrh.) Lej. subsp *sibirica* V.I. Krecz.: alpine and subalpine meadows, subalpine scrub, tundras; C1 (*).

L. spicata (L.) DC.: forb-sedge-fescue tundra in C1.

Cyperaceae (3/16).

Carex aterrima Hoppe: subalpine and alpine meadows, tundras; C1.

C. brunnescens (Pers.) Poir.: wet meadows, bogs, river and stream banks; C1.

C. cespitosa L.: river and stream banks, bogs; C1, C2.

C. curaica Kunth: wet meadows, bogs; C1.

C. ledebouriana C.A. Mey. ex Trev.: forb-sedge-fescue tundra in C1.

C. macroura Meinsh.: fir-birch-spruce forest in C2.

C. muricata L.: meadows; C2.

C. orbicularis Boott subsp. *altaica* (Gorodkov) T.V. Egorova: boggy scrub of willow and *Betula rotundifolia* in C1 (*).

C. pallescens L.: meadows; C1, C2 (*).

C. pamirica (O. Fedtsch.) O. et B. Fedtsch.: bogs, stream banks; C1.

C. pediformis C.A. Mey.: steppes, steppe meadows; C1, C2.

C. rhynchophysa C.A. Mey.: bogs, river and stream banks; C2 (*).

C. rostrata Stokes: lake shores, river and stream banks; C1 (*).

C. tristis M. Bieb. subsp. *stenocarpa* (Turcz. ex V.I. Krecz.) T.V. Egorova: rock in C1.

Eriophorum angustifolium Honck.: sedge bog in stream valley; C1.

Scirpus sylvaticus L.: bog and boggy forest in C2 (*).

Poaceae (19/39).

Agrostis gigantea Roth: steppe meadow in C2 (*).

Alopecurus aequalis Sobol.: wet place at intersection of trail and stream in C1.

A. pratensis L.: meadows; C1, C2.

Anthoxanthum alpinum A. et D. Löve: alpine and subalpine meadows, tundras; C1.

Avenula hookeri (Scribn.) Holub: boulder field in C1.

A. pubescens (Huds.) Dumort.: meadows; C1, C2.

Beckmannia syzigachne (Steud.) Fernald: bog at intersection of stream and country road in C2.

Brachypodium pinnatum (L.) P. Beauv.: steppe meadow in C2.

Calamagrostis epigeios (L.) Roth: steppes, steppe meadows; C2.

C. langsdorffii (Link) Trin.: valley forests; C2 (*).

C. obtusata Trin.: fir-birch-spruce herb forest in C2.

C. purpurea (Trin.) Trin.: meadows, boulder fields; C1 (*).

Dactylis glomerata L.: meadows; C1, C2.

Deschampsia altaica (Schischkin) O.D. Nikif.: wet meadows, bogs, river and stream banks; C1.
D. cespitosa (L.) P. Beauv.: wet meadows, bogs, river and stream banks; C1, C2 (*).
Elymus gmelinii (Ledeb.) Tzvelev: small-stone scree on roadside of country road in C2 (*).
E. mutabilis (Drobov) Tzvelev: steppe meadows; C2 (*).
E. sibiricus L.: small-stone scree on roadside of country road in C2.
Elytrigia gmelinii (Trin.) Nevski: stony steppe in C2 (*).
E. repens (L.) Nevski: meadows; C2.
Festuca kryloviana Reverd.: alpine meadows, tundras; C1 (*).
Melica altissima L.: scrub on scree in C2.
M. transsilvanica Schur: stony steppe in C2.
Milium effusum L.: forests, open forests, subalpine meadows and scrub; C1, C2.
Phleum alpinum L.: subalpine and alpine meadows; C1.
Ph. phleoides (L.) Karst.: steppes, steppe meadows; C2.
Ph. pratense L.: steppe meadows; C2.
Poa alpina L.: country road in C1.
P. attenuata Trin.: rock in C1 (*).
P. nemoralis L.: birch-willow forest in stream valley; C2 (*).
P. pratensis L.: meadows; C2.
P. sibirica Roshev.: meadows, forests; C1, C2.
P. supina Schrad.: trails, river and stream banks; C1.
P. urssulensis Trin.: rocks, stony steppes; C1, C2.
Schedonorus pratensis (Huds.) P. Beauv.: steppe meadow in C2.
Stipa kirghisorum P.A. Smirn.: steppe meadow in C2 (*).
Trisetum altaicum Roshev.: subalpine and alpine meadows, tundras; C1 (*).
T. mongolicum (Hultén) Peschkova: forb-sedge-fescue tundra in C1.
T. sibiricum Rupr.: meadows; C1, C2.

Discussion

The synopsis of the Archatinskoe Forestry includes 393 vascular plant species and subspecies which belong to 201 genera and 58 families. Five species are included to the List of Rare and Endangered plant species of the Republic of Kazakhstan (2006): *Paeonia anomala*, *Rheum altaicum*, *Rhodiola rosea*, *Lilium pilosiusculum* (= *L. martagon*), and *Erythronium sibiricum*. The synopsis of the Chernovinskoe Forestry includes 383 vascular plant spesies and subspecies which belongs to 215 genera and 59 families. Eight species are included to the List of Rare and Endangered plant species of the Republic of Kazakhstan (2006): *Huperzia selago*, *Paeonia anomala*, *P. hybrida*, *Rheum altaicum*, *Rhodiola rosea*, *Fornicium carthamoides*(= *Rhaponticum carthamoides*), *Erythronium sibiricum*, and *Dactylorhiza fuchsii*. De-

spite these species are estimated as rare for the territory of Kazakhstan, they are quite common in the KKSNNP. Nevertheless, they usually are not abundant in the plant communities, except *Fornicium carthamoides*, which is abundant in some subalpine meadows, and *Rhodiola rosea*, which is sometimes abundant at the river and stream banks. Wheres the *Erythronium sibiricum* is an ephemeroid we were able to register only few plants finishing their life cycle in the middle of summer. This species demonstrates abundant flowering in the Altai Mountains from the end of May to the beginning of June.

Data on the plant species diversity of the Archatinskoe and the Chernovinskoe Forestries with the previosly compiled plant checklists and synopses of other territories from the KKSNP can be used to complete the first synopsis of native vascular plants of the KKSNNP. The alien fraction of the flora requires additional field research in the most visited sites of the KKSNNP: the tourist camp at Lake Yazovoe and the Sanatorium Rakhmanov Springs.

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